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TM 9-850

WAR DEPARTMENT TECHNICAL MANUAL

CLEANING, PRESERVING, SEALING, LUBRICATING AND RELATED MATERIALS ISSUED FOR ORDNANCE MATERIEL

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WAR DEPARTMENT

24 AUGUST 1944

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TM 9-850

This Technical Manual supersedes TM 9-850, dated 13 April 1942, including Changes No. 1, dated 23 December 1943; TB 850-5, dated 19 November 1942; TB 850-7, dated 26 November 1942; TB 850-8, dated 25 November 1942; WDTB 9-850-4, dated 30 October 1942; WDTB 9-850-13, dated 13 March 1944; WDTB ORD 75, dated 10 April 1944, and pertinent information in TB's 700-20 and 850-3, both dated 13 October 1942; TB's 850-9, 1245-2, 1307-1, and 1325-1, all dated 5 February 1943, and WDTB ORD 17, dated 11 November 1942.

CLEANING, PRESERVING, SEALING, LUBRICATING AND RELATED MATERIALS ISSUED FOR ORDNANCE MATERIEL



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SFUND RECORDS CTR
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WAR DEPARTMENT
Washington 25, D. C., 24 August 1944

TM 9-850, Cleaning, Preserving, Sealing, Lubricating and Related Materials Issued for Ordnance Materiel, is published for the information and guidance of all concerned.

[A.G. 300.7 (19 May 44)
O.O. 300.7/2717]

BY ORDER OF THE SECRETARY OF WAR:

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Chief of Staff.

OFFICIAL:

J. A. ULIO,
*Major General,
The Adjutant General.*

DISTRIBUTION: As described in Par 9a, FM 21-6; C and H (2); Ord Decent. Sub O (3); PE (Ord O) (5); H & R Points (5); Ord Dist O (5); Ord Reg O (3); Ord Dist Br O (3); Ord Estab (5); Ord TK Dep (3).

(For explanation of symbols, see FM 21-6.)

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Section I

GENERAL

1. PURPOSE.

a. The purpose of this Technical Manual is to provide using organizations and Ordnance maintenance personnel with general information regarding the characteristics, container or package sizes, use, and applications of cleaning, preserving, sealing, adhesive, lubricating and related materials issued for the maintenance and preservation of Ordnance materiel.

b. The instructions herein are general in scope and do not supersede instructions in War Department regulations, War Department Lubrication Orders, or Technical Manuals for specific items of materiel.

2. REFERENCES.

a. Materials included in this manual are also listed in SNL K-1, which provides specification numbers, Federal and item stock numbers, container or package sizes, unit prices, and issuing agency for each item.

b. Information concerning welding, brazing, cutting, and soldering materials formerly included in this manual is now covered in TM 9-2852.

c. Refer to TM 9-1799 for instructions covering maintenance of fire extinguishers.

d. Refer to TM 3-220 for instructions on decontamination of Ordnance materiel.

e. Refer to TM 9-2851 (when issued) for information concerning paint, brushes, and related materials.

f. Refer to TM 9-2835 (when issued) for more detailed information regarding lubricants and applications thereof. This manual will supersede the TB 2835-series and the manual, "Lubrication of Ordnance Materiel," when issued.

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Section II

ABRASIVE MATERIALS

3. CLOTH, ABRASIVE, ALUMINUM-OXIDE.

a. **Characteristics.** A natural emery or artificial aluminum oxide abrasive on cotton drill or jean cloth. Various sizes of grain are available as listed in SNL K-1, and the grain size of any particular kind is usually marked on the back of the cloth.

b. **Unit Size.**

Sheets, 9 x 11 inches, packaged in quires.
Rolls, 50 yards, width: 1, 1½, and 2 inches.

c. **Use.**

(1) **GRADES 2/0 AND FINER (GRAIN SIZE 100 AND HIGHER).** Used for polishing, cleaning, and removing rust from finished iron and steel surfaces in ordinary machine work, the finest sizes (4/0 and finer) being used for the more highly finished surfaces. Properly qualified Ordnance personnel may use grades as coarse as No. 2/0 for removal of burs from threads of breech blocks and breech recesses, gas-check split rings, and gas-check seats, steel shanks of sight mountings, and bearing sleeves of range finder, and battery commander's telescope tripods. No abrasive cloth coarser than 2/0 is permitted for work on breech mechanisms. To prevent unnecessary wear, crocus cloth should be used on these mechanisms, when possible.

(2) **GRADE 0 AND COARSER (GRAIN SIZE 80 AND UNDER).** Used generally for removing rust, burs, and other defects from unfinished iron and steel surfaces and in preparing such surfaces for painting. These coarse sizes should never be used on highly finished surfaces. Grade 0 may be used on nonbearing finished surfaces where slight removal of metal does not affect proper fit.

(3) **ROLLS.** This type of aluminum-oxide abrasive cloth is particularly adaptable to use on material being machined in a lathe and to other uses where the cloth is required to be used in long strips.

(4) **ALL GRADES.** Aluminum oxide abrasive cloth should never be used on soft bearing metal such as brass, bronze, and babbitt as such surfaces become charged with the abrasive which then rapidly wears any contacting metal. Whenever there is reason to suspect that emery or aluminum oxide abrasive has entered any bearing, disassemble it immediately and thoroughly clean it. Never use this abrasive cloth to polish commutators of generators since the abrasive dust will cause short circuits. Flint paper may be used for this purpose if the commutator is not too deeply ridged or worn.

ABRASIVE MATERIALS

4. CLOTH, CROCUS.

a. **Characteristics.** Fine, soft, red, or reddish-brown powder (tripoli or iron oxide) on cotton drill or jean cloth.

b. **Unit Size.** Sheets 9 by 11 inches, packaged in quires.

c. **Use.** Used for cleaning and polishing finely finished surfaces such as rifle parts, breech blocks, gun slides, etc. First and second echelon personnel will use nothing coarser than crocus cloth for removing rust stains from highly finished surfaces. Whenever rusting or scoring is of such character that it cannot be removed with crocus cloth, Ordnance personnel should be notified.

5. CLOTH, EMERY.

a. Refer to CLOTH, abrasive, aluminum-oxide.

6. DISKS, SANDING.

a. **Characteristics.** Disks of sandpaper of various types, sizes, and coarseness, as listed in SNL K-1.

b. **Unit Size.** Separate sheets having dimensions shown in SNL K-1.

c. **Uses.** The type of sandpaper used on sanding disks varies in accordance with the type of work to be done. These types are referred to as special, open grain, and closed coat. The disks are used with motor-driven sanders, the disks being glued to the rotating element. The various sizes and types are used in shops for removing old paint and rust and for general conditioning of metal surfaces preparatory to painting.

7. PAPER, ABRASIVE, ALUMINUM-OXIDE, PRODUCTION TYPE.

a. **Characteristics.** This is similar to abrasive cloth aluminum-oxide, but having a special construction and type of grain to provide a more rapid cutting action. Grain sizes are usually stamped on the back of the cloth.

b. **Unit Size.** Sheets 9 by 11 inches, packaged in quires.

c. **Use.** Used principally for wet sanding of bare metal with gasoline preparatory to painting automotive and large artillery materiel.

8. PAPER, ABRASIVE, ARTIFICIAL, WATERPROOF, SILICON CARBIDE.

a. **Characteristics.** A silicon carbide abrasive on a strong, waterproof paper backing. Various grain sizes available are listed in SNL K-1 and consist principally of finer grades than aluminum-oxide abrasive cloth.

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b. **Unit Size.** Sheets 9 by 11 inches.

c. **Use.** Used for wet sanding of metal surfaces where fine finishes are desired, and it is necessary to use water in connection with the sanding operation.

9. PAPER, EMERY.

a. Refer to CLOTH, abrasive, aluminum-oxide.

b. **Characteristics.** Has the same characteristics as CLOTH, abrasive, aluminum-oxide, except that the abrasive is on a paper backing instead of cloth. This item has been canceled and aluminum-oxide abrasive cloth should be used in lieu thereof.

10. PAPER, FLINT, CLASS B.

a. **Characteristics.** Crushed flint rock of various grain sizes from No. 2/0 to No. 3 glued to heavy paper sheets. This is the common variety of sandpaper.

b. **Unit Size.** Sheets 9 by 11 inches in grades, packaged in quires.

c. **Use.** Class B flint paper is generally used for sanding wood surfaces before painting and for metal surfaces where aluminum-oxide abrasive cloth cannot be used. (See CLOTH, abrasive, aluminum-oxide.) Typical uses are as follows:

(1) No. 2/0: Sanding wood surfaces such as rammer staves and plotting boards for varnishing; cleaning and smoothing generator commutators.

(2) No. 1/2: Rubbing down under-coats of paint and varnish in preparation for the final coat. This is the coarsest grain allowed for rubbing down stocks of small arms.

(3) No. 1 to No. 3: For rubbing down old coats of paint preparatory to repainting, the finer grades being used where an old coat is in fair condition and the coarser grades where the old paint is in bad condition and must be removed before repainting. It has been found that grades No. 2 1/2 and No. 3 are very rarely needed, and these grades are to be canceled when present stocks are depleted.

11. SAND, SPARK PLUG CLEANER.

a. **Characteristics.** A special, fine abrasive material resembling fine sand. Its hardness and abrasiveness is controlled so as not to produce excessive cutting of spark plug insulators during the cleaning operation.

b. **Container.** 3-pound can.

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c. **Use.** Used in air blast type spark plug cleaners. Ordinary fine sand should not be used in these cleaners because it is so abrasive that it abrades spark plug insulators excessively. Spark plug cleaner sand avoids this.

12. WOOL, STEEL, COMMERCIAL.

a. **Characteristics.** A fluffy or wool-like mass of steel turnings or threads.

b. **Unit Size.** One-pound rolls, three grades No. 0, 1, and 3.

c. **Uses.** A mild abrasive for rubbing down and smoothing wood or painted surfaces and for removal of light rust from steel parts. Its finely divided nature makes it particularly susceptible to rusting and consequent crumbling, after which it cannot be used for its intended purposes. Care should therefore be taken to store it in a dry place, protected from the elements.

Section III

CLEANING MATERIALS AND SERVICES

13. CLEANING SERVICES.

a. **Cooling Systems, Engines.**

(1) **GENERAL.**

(a) The efficiency of cooling systems of internal combustion engines can be greatly impaired by corrosion and scale formation, with the resultant clogging of the system. To avoid such difficulties, cooling systems must be cleaned periodically to remove rust, scale, and foreign accumulations, and then protected with a corrosion inhibitor to prevent further rusting.

(b) The tendency for rust and scale to form in cooling systems depends on the types of materials used therein, operating conditions, and the amount of impurities in the coolant. Water containing high percentages of certain minerals and impurities will increase the rate of rust and scale formation.

(2) **PROCEDURE.** Cooling systems should be cleaned at least twice a year; before the antifreeze compound (ethylene glycol type) is installed, and again after it is removed. In addition, rusty or otherwise contaminated coolant, or rust and grease deposits inside the radiator indicate that cleaning of the cooling system is necessary. Cleaning at the prescribed intervals will reduce clogging and overheating to a minimum, and will largely eliminate the necessity for corrective cleaning by a higher echelon. If the cooling system is very dirty, or

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clogged so that overheating occurs, the condition should be reported to Ordnance personnel. The entire cooling system should be examined for leaks both before and after cleaning and flushing. **CAUTION:** *Do not under any circumstances, mix the cleaning material with neutralizer, antifreeze compound, or corrosion inhibitor compound. The approved cleaning compound consists of a cleaner and a neutralizer, packed in separate containers in a single package.*

(a) Cleaning.

1. Open the petcocks which shut off the coolant from the heaters or other accessories, to allow for complete circulation during the cleaning, flushing, and draining. Run the engine, with the radiator covered if necessary, until the temperature is within operating range. Stop the engine, turn radiator cap to release pressure and then remove the radiator cap and drain the system by opening the drain cocks and removing plugs in the radiator and block; check with the cooling system drain caution plate on the instrument panel for position of drains, if the vehicle is equipped with such a plate. If necessary, use a wire to keep open any drain hole which tends to become clogged.

2. Allow the engine to cool below 200° F. Disconnect the radiator overflow return tank, if the vehicle is so equipped. Close the drain cocks and replace plugs; pour water slowly into the radiator until the system is approximately half full. Start the engine and run it at idling speed while adding cleaning compound, in the proportion of one container of cleaner to every 4 gallons of cooling system capacity. Immediately complete filling the system with water. Never mix the water and the cleaning compound before putting them into the system. **CAUTION:** *Do not spill the solution on skin, clothing, or painted portions of the vehicle. If spilled, flush with water immediately.*

3. Place a clean drain pan in position to collect the overflow, using the overflow to maintain the level in the radiator, if necessary.

4. Replace the radiator cap and run the engine at fast idling speed, covering the radiator if necessary, until the coolant reaches a temperature above 180° F but not over 200° F. Do not drive the vehicle. Constantly check the level in the radiator.

5. Stop the engine after it has run for 30 minutes at at least 180° F but not over 200° F. Then remove the radiator cap and drain the system completely.

(b) Neutralizing.

1. Allow the engine to cool below 200° F. Close the drain cocks, replace plugs, and pour water slowly into the radiator until the system is approximately half full. Start the engine and run it at idling speed while adding neutralizer compound in the proportion of one

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container of neutralizer to every 4 gallons of cooling system capacity. Immediately complete filling the system with water.

2. With the radiator covered, run the engine idle for at least 5 minutes at the normal operating temperature. Then stop the engine.

3. Drain the system completely by removing the radiator cap and opening all the drain cocks, and removing plugs.

(c) Flushing.

1. Allow the engine to cool below 200° F. Close the drain cocks and replace plugs. Then start engine, run at idling speed, and pour water slowly into the radiator until the system is full.

2. Run the engine at fast idle keeping the radiator covered if necessary until the coolant is heated to the normal operating temperature.

3. Drain the system by removing the radiator cap, opening all the drain cocks, and removing plugs. Repeat the flushing operation until the drain water is clear.

4. Again allow the engine to cool and then clean all sediment and foreign matter from the radiator cap valves and the overflow valves. Blow insects and dirt from radiator core air passages with compressed air, blowing in a direction opposite to the normal flow of air when the engine is operating. Use water, if necessary, to soften obstructions.

5. If the system is equipped with an overflow tank, flush the overflow tank and pipe by filling with water and then draining both completely.

(d) *Leaks.* After completing the flushing operation, allow the engine to cool below 200° F. Close the drain cocks and replace plugs. Pour water slowly into the radiator until the system is approximately half full. Start engine and run at idling speed, and fill the system completely. Stop the engine and examine the entire cooling system for leaks. This is important because the cleaning solution may uncover leaks which already exist but are plugged with rust or corrosion. Reconnect overflow tank if it had been disconnected and inspect caps and gaskets to be sure they are in good condition and fit securely. Leaks that cannot be corrected by the using arm should be reported immediately to Ordnance maintenance personnel.

(e) *Coolant Service.* When servicing the vehicle for operation at anticipated temperatures either above +32° F or below +32° F, refer to paragraph 37.

b. Artillery Breech and Firing Mechanisms.

- (1) Daily, and immediately after firing, the breech and firing mechanisms of guns and howitzers using fixed or semifixed ammunition will be cleaned thoroughly with dry-cleaning solvent dried

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thoroughly, and coated with a thin film of engine oil (SAE 30 above +32° F, SAE 10 from +32° F to 0° F), or preservative lubricating oil (special) below 0° F. Application to moving parts will be by oil-can if oilholes are provided, otherwise with a clean wiping cloth. Disassembly will be undertaken if necessary to insure complete lubrication of all moving parts.

(2) Special care must be given to the breech mechanism of cannon using separate-loading ammunition. The entire breech mechanism, including the firing mechanism, obturator spindle, primer seat, primer vent, filling-in disks, split rings, etc., except the gas-check pad, should be disassembled and cleaned immediately after firing except in the case of firing locks of seacoast artillery material, use the same solution used to clean the bore. All traces of powder fouling and primer residue should be carefully removed. After rinsing in clean water, dry thoroughly and coat with engine oil (SAE 30 above +32° F, SAE 10, +32° F to 0° F, or preservative lubricating oil (special) below 0° F). Application to moving parts will be made by oilcan if oilholes are present, otherwise with a clean wiping cloth. Cleaning will be repeated daily until all traces of primer residue have been removed. Firing locks of seacoast artillery materiel will be cleaned with dry-cleaning solvent, wiped thoroughly dry, and oiled.

(a) During firing, whenever the rate of fire permits, remove powder fouling from the primer seat and primer vent.

(b) Daily, or at intervals prescribed by the officer in charge, disassemble parts and clean with dry-cleaning solvent. Dry thoroughly and coat parts with oil prescribed for prevailing temperatures. Special precautions must be taken to apply only a light film to split rings.

c. Gas-check Pad. Extreme care should be exercised in cleaning the gas-check pad of all weapons using separate-loading ammunition. After removal from the obturator spindle, the gas-check pad will be wiped clean with a dry cloth, and then oiled, lightly, with a clean cloth wet with engine oil (SAE 30 above +32° F, or SAE 10 below +32° F). Excess oil causes rapid deterioration; therefore, gas-check pads will not be soaked in oil. Never clean the gas-check pad with dry-cleaning solvent or any other type of cleaning solution. CAUTION: When cleaning the tube and breech assemblies, precaution should be taken that no dry-cleaning solvent ever comes in contact with the gas-check pad.

d. Gun and Howitzer Bores.

(1) As soon as possible after firing, while the tube is still hot, clean the bore to insure complete removal of powder residue and primer salts. Under no circumstances will the gun remain for an extended period without cleaning after it has been fired. Swab the

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bore with a cleaning solution of one-half pound of soda ash to each gallon of warm water. Only the regularly issued bronze bore brush will be used for swabbing the bore. Rinse with clean warm water. After drying thoroughly with jute, burlap, a film of engine oil (SAE 30 above +32° F, SAE 10 from +32° F to 0° F), or preservative lubricating oil (special) below 0° F, will be applied with clean, dry burlap. If soda ash is not available, a soap sponging solution will be prepared by dissolving one pound of castile soap in 4 gallons of water. If castile soap is not available, government issue soap may be used as a substitute. The soap should be shaved from the bar to facilitate dissolving. It is then added to the water and the water heated until the soap is dissolved. The water should be stirred as quietly as possible to prevent foaming. To avoid the necessity of handling large receptacles, as much soap as is required for all the water to be used can be dissolved in one pail of water. This concentrated soap solution can then be added to water in other receptacles to make up the prescribed proportions. Special precautions must be taken to rinse the bore thoroughly before drying if government issue soap is used in the solution, because of the possibility of soap leaving a gummy residue, and of corrosion from the presence of free caustic in the soap. In an emergency, water alone, preferably hot, may be used for cleaning. The cleaning process will be repeated daily for 3 days or more, until there is no longer any evidence of sweating. A uniform gray appearance is indicative of a clean bore. Because of the possibilities of damage to the bore, decoppering is prohibited. Steel wire bore brushes will not be used. Bronze wire brushes are furnished for removing light rust and residue. No attempt will be made to use them for polishing bores, as such use will wear the lands and affect the accuracy of fire.

(2) Daily, clean the bore by thoroughly wiping with clean burlap, and then oiling with the grade of engine oil prescribed for the bore.

(3) Every 5 days, if the gun or howitzer has not been fired during that period, swab the bore with dry-cleaning solvent, dry, and reoil.

(4) Before firing, wipe the bore clean, dry burlap to insure that it is clean and dry.

(5) During firing, whenever the rate of fire permits, examine the bore for powder fouling. Clean with bore brush if necessary. Chambers of cannon using separate-loading ammunition are sponged after each round with plain water only.

(6) The cleaning of a cold gun tube after firing cannot be accomplished in the normal manner at temperatures below +32° F because the water in the cleaning solution will freeze in the tube. If cleaning can be done with the tube hot, and hot water is available, it may be

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possible to use the normal soda ash or other cleaning solutions. Otherwise, it will be necessary to add denatured alcohol or as emergency alternative, glycerine or antifreeze compound. To 10 parts by volume of cleaning solution, add the number of parts of one of the antifreeze solutions listed below. If it is not possible to mix a cleaning solution with an antifreeze solution as indicated above, the bore may be cleaned with dry-cleaning solvent. This should be done only in an emergency since it is not very effective as a cleaning solution after firing.

Temperature °F	ALCOHOL, denatured or	GLYCERINE or	COMPOUND, antifreeze
20	2	2½	2
10	4	5	3⅓
0	6½	6½	5
-15	9	10	7¼
-30	16	13	10
-40	27	16	12

e. Small Arms and Machine Guns.

(1) BORE CLEANING MATERIALS.

(a) Rifle bore cleaner is especially designed for cleaning small arm bores after firing. Although rifle bore cleaner possesses rust preventive properties and will provide temporary protection against rust after a bore has been cleaned, the best practice is to dry the bore immediately after cleaning and apply a film of special preservative lubricating oil to the metal surface.

(b) Soda ash solution is a satisfactory substitute for cleaning bores of small arms. For use, it is dissolved in boiling water in the proportion of 1½ tablespoons of soda ash to 1 pint of water. If boiling water is not available, hot or even cold water may be used. This solution should be used to clean the gun bore when rifle bore cleaner is not available.

(c) Castile soap or issue soap—a solution of soap may also be used for cleaning the bore if neither rifle bore cleaner nor soda ash is available. Prepare the solution by dissolving soap in chip form in hot water in the proportion of one-quarter pound to 1 gallon of water. This solution should be used hot but can also be used cold.

(d) At temperatures below freezing, antifreeze materials such as alcohol, glycerine, or antifreeze compound may have to be added to bore cleaners except rifle bore cleaner.

(e) Dry-cleaning solvent is a petroleum solvent used for degreasing. It will remove all oily films from metal parts and its use therefore should always be followed immediately by application of a film

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of preservative lubricating oil or rust preventive compound. In an emergency, Diesel fuel oil may be used in lieu of dry-cleaning solvent.

(2) DETAILED CLEANING INSTRUCTIONS.

(a) Small arms will be inspected daily for proper cleanliness and condition. Metal surfaces will be protected with a film of preservative lubricating oil and all moving parts lightly oiled to insure proper functioning. Preservative lubricating oil, light or special, is prescribed for weapons on the ground at all temperatures above 0° F, except in preparing for surf landing operations, when preservative lubricating oil (medium) will be used. For all temperatures below 0° F, preservative lubricating oil (special) is prescribed.

(b) To provide the maximum protection against rust, the gun will be completely disassembled when inspecting, cleaning, or oiling the various parts. Always clean and dry all parts thoroughly before preservative lubricating oil is applied. In damp climates take care that patches or wiping cloths used for drying are truly dry and are not damp with atmospheric moisture.

(c) As soon as possible after firing, the bore will be cleaned, dried and oiled. Saturate a clean cut patch (canton flannel), with rifle bore cleaner, attach to the cleaning rod, insert rod at the breech end of the barrel, and push it back and forth through the bore. Be sure that the patch goes completely through the bore before the direction is reversed. Repeat this procedure with clean patches two or three times. Follow this with dry patches until they come out clean and dry. Examine bore and chamber carefully for cleanliness. If not free of all powder residue and primer fouling, repeat cleaning process. When clean, saturate a patch in preservative lubricating oil and push it through the chamber and bore several times.

(d) To clean the bores of all machine guns, except Thompson sub-machine gun, with a soda ash or soap solution, place the barrel, muzzle down, in a vessel containing the cleaning solution. In an emergency, use hot or cold water alone. Insert the cleaning rod, with a flannel patch, into the breech end. Move rod up and down for about one minute, pumping the solution in and out of bore. Run a brass or bronze wire brush forward and back through the barrel three or four times while the bore is wet. Do not reverse direction of travel of metal brushes while they are in the bore. Using cleaning rod and clean patch, pump clean water through the bore in a similar manner in order to remove all traces of the cleaning solution. Remove barrel from the water and dry it with a clean patch. When the bore and chamber are clean and dry, saturate a patch in preservative lubricating oil and push it through the chamber and bore several times.

(e) The cleaning and reoiling procedure, following firing, will be repeated daily for 3 consecutive days to insure complete removal of

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powder residue and primer fouling. If inspection at the end of the 3-day period reveals that there is still evidence of sweating, repeat the cleaning process daily until sweating stops.

(f) Thereafter, at the first sign of rust, the bore will be cleaned with dry-cleaning solvent, dried thoroughly, and reoiled. If no rust is detected, renew the oil film every 5 days. Remove accumulations of dust, dirt, and thickened oil by wiping the bore with clean patches. Attach patch to cleaning rod, insert in bore, and move backward and forward several times. Make sure that each stroke is the full length of the bore. Repeat with additional patches until a patch remains clean. Be certain that the chamber, as well as the bore, is thoroughly cleaned. After thorough cleaning, saturate a patch with preservative lubricating oil and push through the chamber and bore several times. When issue patches are not available, patches should be cut approximately 2½ inches square to permit their passage through the bore without bending the cleaning rod.

(3) OTHER PARTS.

(a) As soon as possible after firing, clean the gun, other than the bore, by wiping the moving parts and all metal surfaces with dry-cleaning solvent. Dry thoroughly and then apply a light film of oil with a patch dampened with preserving lubricating oil. Repeat this cleaning and reoiling procedure at any time that daily inspection reveals that rusting is taking place. Otherwise, every 5 days, disassemble all moving parts. Clean screwheads and crevices with a small cleaning brush or small stick. Clean moisture and dirt from the metal surfaces by rubbing them with a dry wiping cloth. Then wipe them with a cloth that has been dipped in preservative lubricating oil. The film must be maintained at all times. Clean the dirt from the outer metal surfaces with an oiled wiping cloth, and then re-wipe with a clean wiping cloth or patch wetted with preservative lubricating oil.

(b) Before firing, wipe the bore with clean dry patches to remove all traces of oil and any foreign material that may have accumulated. Clean all metal surfaces and moving parts to remove any dust or dirt, and lightly wipe with a patch or wiping cloth wetted with preservative lubricating oil. Do not oil the chamber as excessive pressures may develop, causing injury to personnel and the weapon.

(c) Only the slightest film of oil will be applied in sub-zero temperatures. Apply the oil by rubbing the parts with a patch which has been wet with preservative lubricating oil (special) and wrung out. When a gun, exposed to low temperatures, is brought indoors, moisture condenses on the metal surfaces and causes rusting. Therefore, guns should be left exposed to the cold or disassembled, wiped dry, and reoiled immediately after they have warmed up to the building temperatures. This latter procedure is necessary each time

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the materiel is brought from a cold to a warm atmosphere. If the gun has been fired, it should be thoroughly cleaned and oiled. The bore should be swabbed out with oily patches and when the weapon reaches room temperature, thoroughly cleaned and oiled.

(d) Where temperature and humidity are high (or where salt air is present) and during rainy seasons, the weapon should be thoroughly inspected daily and kept lightly oiled with preservative lubricating oil (medium) when not in use. The groups should be dismounted at regular intervals and, if necessary, completely disassembled to enable the drying and oiling of all parts.

(e) In sandy terrain, wind-blown sand sticks to surfaces coated with a film of oil. Sand causes malfunctioning and rapid wear. Under such conditions, wipe the weapon clean daily and leave most exposed parts, such as elevating and traversing racks and similar mechanisms, dry. Groups will be dismounted and disassembled to facilitate thorough cleaning. A light film of prescribed oil may be applied to parts which are not apt to collect sand. Perspiration from the hands is a contributing factor to rust because it contains acid. Therefore, metal parts should be wiped dry frequently. During sand or dust storms, breech and muzzle should be kept covered if possible. Immediately upon leaving sandy terrain, the weapon must be cleaned and relubricated with the correct preservative lubricating oil.

f. Optical Glass.

(1) GENERAL. The function of any optical element is to transmit light by reflection or refraction in accordance with a predetermined formula. It follows from this that the serviceable life of any optical element will be determined only by the care and consideration it receives and the conditions under which it is used. Several factors affect the serviceability of optical glass:

(a) Chemical decomposition of the glass occasioned by the presence of dust, moisture, acids, etc.

(b) Carelessness in handling and lack of knowledge concerning the precautions that are necessary.

(c) Imperfections due to manufacture which are unavoidable and can only be remedied by replacement.

(2) MAGNESIUM FLUORIDE COATING.

(a) General.

1. A process has been developed for the coating of air-to-glass surfaces to increase the optical efficiency of fire control and other optical instruments. At the present time, the instruments having coated optics include all telescopes of the M70-series, and some of the current production of Telescopes M51, and Height Finders M1.

2. The present coating consists of magnesium fluoride applied in

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films of thickness of one-quarter wave length of light. The coating is durable enough to handle during assembly and disassembly, and is able to withstand a limited amount of careful cleaning. Variations and modifications which will improve the process and the coating will be adopted from time to time.

NOTE: *Filters, reticles, and lenses lying in the focal plane of the objective lens or of the erecting system are not coated.*

(b) Purpose.

1. The coating reduces the amount of light reflected from the optical surface, resulting in a corresponding increase in the amount of light transmitted through the lens.

2. The normal reflection from uncoated optical surfaces is from 4 percent to 6 percent per surface on all air-to-glass surfaces, both for entering rays and for rays leaving the optical elements. The coated surface reflects approximately 1 percent per surface. This reduction of reflection is responsible for the increase of transmission and the elimination of glare, halos, and ghost images within the instrument.

3. The over-all increase in the light transmitted through an instrument may be considerable. In a telescope of the M51 or M70 type, with seven optical elements coated (all but the reticle and filters) the light passing through on a given occasion will be about 50 percent greater than would pass through the instrument were its optics uncoated.

4. The increase of light transmission is very noticeable during night operations and under other conditions of poor illumination; visibility of targets is increased 15 to 30 minutes longer at dusk and at dawn. Also, the range of vision at night is increased approximately 20 percent for standard binoculars with coated surfaces. The halos and ghost images which are normally present in uncoated instruments are practically eliminated in coated instruments. Thus, great advantages are obtained when spotting or observing in the direction of the sun.

(c) *Identification of Coated Instruments.* Instruments which have coated lenses can be identified by careful inspection.

1. Hold the instrument at an angle to a natural or artificial source of light. Observe the reflections from the eye and objective lens. If the optics are coated, the reflection of the light source will have a distinctive purplish tinge. Under certain conditions, this tinge may have the appearance of a dull film on the face of the lens.

2. An alternative method is to take the instrument and compare it with an uncoated instrument of equivalent model number or series. Look at the same object with each instrument, comparing the illumina-

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tion of the two fields of view. The coated instrument will have a much brighter field.

(d) Care of Coated Instruments.

1. *General.* Inexperienced personnel, noting the film caused by coating of the optical components, may decide that it is a chemical deterioration of the glass and attempt to remove it. Supervising officers and noncommissioned officers with Ordnance maintenance organizations, must take every precaution to see that this does not occur. The purpose of the coating and the proper care and maintenance of coated instruments should be understood thoroughly by all Ordnance field maintenance personnel engaged in the servicing of any fire control and sighting equipment of an optical nature issued by the Ordnance Department. Whenever possible, the maintenance of coated optical instruments should be supervised by competent specialized personnel.

2. Cleaning.

a. Never use jewelers' rouge or abrasives of any kind in the cleaning of coated optical components.

b. Since coated lenses are designed to withstand a limited amount of cleaning, the use of ethyl alcohol grade 1, and lens cleaning liquid soap will not unduly affect them. However, excessive rubbing will remove the fluoride coating from the lenses and must be avoided.

NOTE: *Partial or complete removal of the coating does not make the optical element useless. It merely takes away the benefits of the coating, leaving the optical element as if it had never been coated.*

3. *Precautions to be observed during disassembly, assembly, and sealing.*

a. Disassembly and assembly.

(1) During disassembly and assembly of optical instruments possessing coated optics, every effort should be made to prevent the fingers from coming in contact with polished coated surfaces of lenses and prisms.

(2) To prevent any possibility of injury, all coated optical components should be carefully wrapped and identified, in keeping with accepted methods. Under no condition should coated optics be wrapped with unclean lens tissue or other unclean materials.

b. *Sealing.* Coated optics and instruments with coated optics are sealed in the ordinary manner, according to accepted standards. However, exceptional precautions must be taken to prevent sealing and cementing compounds from getting on the surface of the lens. The removal of such compounds would result in injury to the coated optics.

(3) CARE OF UNCOATED OPTICAL GLASS.

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(a) During storage or while in use, optical parts of instruments must be guarded from heat such as would occur if equipment were exposed to direct rays of the sun in midsummer.

(b) If water remains on optical elements, the surface may become etched or pitted. It is, therefore, important to keep optical instruments clean and dry and to store them in dry places. Moisture may condense on the optical parts. If not excessive, this moisture may be removed by placing the instrument in a warm place. Heat should not be applied directly to optical parts.

(c) No wiping materials other than lens tissue paper should be used in the field on optical parts of instruments. Under no circumstances, should polishing pastes or abrasives be used for polishing lenses. Chamois skins are very objectionable as they quickly gather grit, dirt, or dust, and are likely to scratch the surface. Waste or cloths should not be used, as they are hard and may contain grit. The presence of grease, dirt, and dust which ordinarily contain acids, produce a film on the surface of the optical glass. The formation of this film is undesirable and must be removed. To remove oil or grease from the surfaces of lenses and optical instruments, use lens cleaning liquid soap applied with a tuft of lens tissue paper. Rinse with clear water; then clean and dry with lens tissue paper. Never use a water solution containing alkali for cleaning optical glass since the alkali will attack and rapidly etch the glass. In the field, the optical surfaces may first be moistened by the breath and the surface then cleaned and dried with lens tissue paper. Avoid hard rubbing.

(d) Removal of lenses and prisms from instruments for cleaning is not permitted except by trained Ordnance personnel.

(e) Lenses and prisms that are extremely dirty may be brushed with a clean camel's-hair artist brush wetted with lens cleaning liquid soap. Rinse with clear water. *Never use hot water.* Brush across the lens lightly with camel's-hair brush until the surface film has been completely removed. Wipe clean and dry with clean, dry lens tissue paper. Dust may be removed before applying lens cleaning liquid soap by brushing the glass lightly with a clean camel's-hair brush, which should then be rapped against a hard object to remove the small particles of dust that cling to the hair. With some instruments, an additional brush with coarse bristles is provided for cleaning mechanical parts. Use each brush for the purpose intended.

(f) When a solvent is required, ethyl alcohol grade 1, may be applied with either a camel's hair artist brush or lens tissue paper. On evaporation, ethyl alcohol leaves a perfectly clean surface free from wax or gums of any kind. Alcohol should be used sparingly and should not be allowed to run in between the lens and lens mounting. After evaporation, wipe with lens tissue paper.

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(g) Exposed optical parts of instruments which become coated with a film of chemicals during gas attacks should be wiped clean with clean, dry lens tissue paper. Moisten with the breath and repeat the operation several times if necessary, but rub gently. If the film is difficult to remove, apply ethyl alcohol or lens cleaning liquid soap and again rub gently with lens tissue paper. If this does not clean the optics properly, it will be necessary to return the equipment to the Ordnance shop for overhaul and repair.

g. Cleaning of Metal Parts.

(1) SOLVENT, dry-cleaning, or OIL, fuel, Diesel, will be used to wash or clean all metal parts, except during major overhauls when vapor degreasing may be used if available. Use of gasoline for this purpose is prohibited as it creates a fire hazard and leaded gasoline may cause serious injury to the skin.

(2) Cleaning may be accomplished by immersing in the liquid, scrubbing with brush if necessary, or by swabbing with a cloth saturated with the cleaning fluid.

(3) Cleaning will not be done near an open flame as the prescribed materials, although much less inflammable than gasoline, will ignite when in direct contact with a flame.

(4) All parts must be thoroughly dried before a coating of oil or grease is applied. Lubricant will not adhere to a metal surface wetted with solvent.

14. CLEANING MATERIALS.

a. Cloth, Waste, and Sponges.

(1) BURLAP, JUTE.

(a) *Characteristics.* A coarse, heavy, loose-weave, 8-oz cloth.

(b) *Issue.* 40 in. wide, per yard.

(c) *Use.*

1. Placed over the bore sponge or brush for cleaning artillery bores.

2. Covering for artillery breeches and muzzles during stand-by or storage.

(2) OSNABURG, BOTTOM, UNBLEACHED, CLASS B (CLOTH, COTTON, OSNABURG).

(a) *Characteristics.*

1. A coarse, heavy cloth used as a substitute for BURLAP, jute.

(b) *Size.* 8 oz, 39½ in. wide, per yard.

(c) *Use.* Same as BURLAP, jute.

(3) CLOTH, BATISTE, WHITE.

(a) *Characteristics.* A fine grade of soft, lintless cotton cloth.

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- (b) *Size.* Pieces 4 in. x 6 in., 100 per packet.
- (c) *Use.* Wiping cloth for certain fire control instrument elements when the slightest trace of lint may cause malfunctioning.
- (4) **CLOTH, WIPING, COTTON, TYPE II, CLASS A.**
- (a) *Characteristics.* A cloth that is relatively free from lint.
- (b) *Container.*
 - 1. 5-lb bag.
 - 2. 100-lb bale.
- (c) *Use.*
 - 1. Substitute for cotton waste especially when lint deposits may affect operation of the materiel.
 - 2. Substitute for sponges when washing vehicles.
 - 3. Application of strong soap, lyes, soda ash, or other alkaline solutions which quickly deteriorate sponges.
- (5) **PATCHES, CUT (COTTON FLANNEL).**
- (a) *Characteristics.* A good grade of cotton flannel.
- (b) *Package.*
 - 1. 2½-in. squares, 1,000 to the package.
 - 2. 2½-in. squares, 20 per envelope for overseas shipment only.
- (c) *Use.* Used in cleaning bores of small arms and machine guns.
- (6) **SPONGE, CELLULOSE, COARSE PORE, RECTANGULAR.**
- (a) *Characteristics.* A synthetic, cellulose sponge.
- (b) *Sizes.*
 - 1. Size 6 (medium), 1⅜ in. x 3¼ in. x 5 in.
 - 2. Size 10 (large), 2¼ in. x 4⅜ in. x 6¼ in.
- (c) *Use.* Used primarily for cleaning leather and similar materials. It is not for use with solutions containing soda ash, trisodium phosphate, or caustic soda (lye).
- (7) **SPONGE, NATURAL, UNBLEACHED, SIZE E, TYPES III OR VIII.**
- (a) *Characteristics.* A natural material having a large liquid absorption capacity, which becomes soft on wetting without losing its original toughness.
- (b) *Size.* Classified as size E.
- (c) *Use.* For use with mild cleaning solutions in general maintenance work. It will not be used with solutions containing soda ash, trisodium phosphate, or caustic soda (lye).
- (8) **WASTE, COTTON, COLORED.**
- (a) *Characteristics.* Highly absorbent and, therefore, desirable

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for cleaning and wiping purposes. It has a tendency to shed during use and should not be used where the strands will affect operation of the materiel.

- (b) *Packages.*
 - 1. 5-lb package.
 - 2. 100-lb bale.
- (c) *Use.* General wiping and cleaning where a better grade of material is not required.
- (9) **WASTE, COTTON, WHITE.**
- (a) *Characteristics.* A better grade of cotton waste.
- (b) *Packages.*
 - 1. 5-lb package.
 - 2. 100-lb bale.
- (c) *Use.* General wiping and cleaning.
- (10) **WASTE, WOOL, COLORED.**
- (a) *Characteristics.* A fine grade of extra long fiber woolen waste.
- (b) *Packages.*
 - 1. 5-lb package.
 - 2. 100-lb bale.
- (c) *Use.* Packing journal boxes on railroad cars and similar heavy bearing waste packed boxes.
- b. *Fluids.*
 - (1) **ACETONE, GRADE B.**
 - (a) *Characteristics.*
 - 1. A clear, colorless, volatile, and inflammable liquid. It has a sweetish odor, and is soluble in water and alcohol.
 - 2. Acetone is explosive when mixed with air. It is also toxic and prolonged exposure to the fumes will cause nausea, headache, and eventually chronic disease. It, therefore, should be used in open air or in a well ventilated room and not near an open flame.
 - 3. It must be kept in tightly sealed containers.
 - (b) *Container.* 1-gal can.
 - (c) *Use.*
 - 1. Preparation of paint and varnish remover.
 - 2. To remove varnish-like deposits from engine parts such as breather valves, valve stems, and carburetor parts.
 - (2) **ACID, PHOSPHORIC, METAL CONDITIONER, CONCENTRATED (CONDITIONER, METAL, ACID).**
 - (a) *Type I—Wash-off Type.*

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1. *Characteristics.* A fluid consisting of diluted phosphoric acid, containing water-soluble, nontoxic grease solvents.

2. *Container.* 5-gal bottle (For issue to shops, depots, arsenals, only).

3. *Use.*

a. Diluted with water and used as a dip application for rust removal and preparation of iron and steel surfaces for painting.

b. To be washed off with hot or cold water, preferably hot.

(b) *Type II—Wipe-off Type.*

1. *Characteristics.* Similar to type I, except that the acid concentration is much less.

2. *Container.* 1-gal bottle.

3. *Use.*

a. Diluted with water and applied with swab or brush for rust removal and preparation of iron and steel surfaces for painting.

b. To be removed by wiping with dry or damp-dry rags.

(3) **ALCOHOL, DENATURED, GRADE 2.**

(a) *Characteristics.*

1. A clear, colorless, volatile, inflammable, poisonous liquid.

2. Must not be used near an open flame.

3. Must be kept in tightly sealed containers.

(b) *Containers.*

1. 1-gal can.

2. 55-gal drum.

(c) *Use.*

1. Antifreeze for sponging solutions.

2. Preparation of paint and varnish remover.

3. Emergency substitute for antifreeze compound.

4. Emergency substitute for paint thinner.

5. Solvent or brush cleaner for shellac varnish.

6. To prevent ice formations in fuel tanks.

7. For cleaning hydraulic brake parts.

8. Cutting shellac.

(4) **ALCOHOL, ETHYL, GRADE 1.**

(a) *Characteristics.*

1. A clear, colorless, volatile, and inflammable liquid.

2. Must not be used near an open flame.

3. Must be kept in tightly sealed containers.

(b) *Container.* 1-gal can.

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(c) *Use.* Cleaning of optics of sighting and fire control equipment.

(5) **AMMONIA, AQUA, A.C.S., GRADE B (AMMONIUM HYDROXIDE).**

(a) *Characteristics.*

1. A colorless solution of ammonia gas in water containing about 27-28 percent of ammonia by weight.

2. The fumes are not classified as poisonous, but are very irritating to the nose, throat, and lungs. It is, however, dangerous if splashed into the eyes. The antidote is to wash the eyes with large amount of water. Fresh air is the antidote for nausea.

3. Ammonia on the skin will cause smarting and burning. The antidote is to wash with water, and apply petrolatum, olive oil, lard, or similar grease or oils.

4. It must be kept in tightly sealed containers. Solutions in glass containers may develop a slight turbidity during prolonged periods. This does not reduce the cleaning qualities but it is an indication that the solution strength is reduced and the ammonia content should be increased.

(b) *Container.* 16-oz in a 20-oz bottle.

(c) *Use.* For making lens cleaning liquid soap. 2-oz ammonium hydroxide, 2 oz castile soap in 2 gal distilled water.

(6) **BENZOL, TECHNICAL (BENZENE, GRADE C).**

(a) *Characteristics.*

1. A clear, colorless, volatile, and inflammable liquid, having an odor similar to gasoline. It is soluble in alcohol, insoluble in water. Vapors of benzene are heavier than air, with which it forms explosive mixtures.

2. Benzol is very toxic, and if absorbed into the body by inhaling or through the skin, will cause nausea, headache, extreme fatigue, and anemia, followed by convulsions, paralysis, unconsciousness, and possible death.

3. Because of its inflammable, explosive and toxic nature, Benzol should be used in the open air or in a well ventilated room and not near an open flame.

4. It must be kept in tightly sealed containers.

(b) *Container.* 1-gal can.

(c) *Use.*

1. To remove certain gum deposits formed by oxidation of gasoline. Most effective for this use when blended 50-50 with ACETONE.

2. Used in preparation of paint and varnish remover.

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(7) CARBON TETRACHLORIDE.

(a) Characteristics.

1. A colorless, noninflammable liquid, with an odor similar to chloroform.

2. Vapors are heavier than air.

3. It is poisonous if taken into the body in vapor or liquid form. Headache, nausea, anesthesia, followed by inflammation of the liver and kidneys, and in some cases, unconsciousness and death, may result.

4. If accidentally splashed into the eyes, it will cause considerable pain and watering. The eyes should be washed immediately with large amounts of clean water.

5. In contact with the skin, it may cause slight irritation.

6. It should not be allowed to come in contact with hot surfaces as decomposition by heat will give off an extremely poisonous gas.

(b) Containers.

1. 1-qt can.

2. 1-gal can.

(c) *Use.* To clean electrical wiring and electrical mechanisms which cannot be cleaned with an inflammable solvent because of the fire hazard.

(8) CLEANER, RIFLE BORE.

(a) Characteristics.

1. A water-in-oil emulsion which is clear and transparent when viewed by transmitted light.

2. This fluid dissolves corrosive primer salts deposited in the bore of small arms after firing, and acts as a temporary rust preventive.

(b) Containers.

1. 2-oz can (oval, w/screw top).

2. 6-oz. can.

3. 1-qt can.

(c) *Uses.* For cleaning bores of small arms after firing. The 2 ounce can is carried by the individual soldier and is for cleaning hand and shoulder weapons only.

(9) REMOVER, PAINT AND VARNISH, TYPE II.

(a) *Characteristics.* A noninflammable, organic solvent, with suitable evaporation retarders.

(b) Container.

1. 1-qt can.

2. 1-gal can.

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(c) *Use.* For removing paint and varnish from metal and wood surfaces.

(10) SOLVENT, CARBON REMOVER (CLEANER, CARBURETOR).

(a) Characteristics.

1. A cleansing liquid which readily emulsifies with water.

2. The cleaner is issued in two types called one or two phase. The two phase contains an additional highly volatile ingredient which increases the cleaning action, but this quality results in higher loss ratio due to evaporation. No agitation of the cleaner is prescribed in order to allow the less volatile ingredients to remain on top and thus retard evaporation. When possible, the cleaner should be used in its original container which has a removable top rather than to pour off a portion into another container.

(b) *Container.* 5-gal drum.

(c) Use.

1. To remove gummy deposits from carburetor parts.

2. To clean fuel pumps.

3. To clean pistons and other parts coated with carbon and varnish-like deposits.

(11) (SOLVENT, PETROLEUM DISTILLATE) SOLVENT, DRY CLEANING (STODDARD SOLVENT).

(a) Characteristics.

1. A colorless, inflammable liquid distilled from petroleum. It is not to be used near an open flame.

2. It evaporates quickly without leaving a corrosion-inducing film on metal surfaces.

3. Continual use without gloves will dry the skin and may cause slight irritation. Antidote is to rub grease or oil into the skin to replace the natural oils.

4. It is highly destructive to natural rubber hose, tires, and electrical insulation and should not be used on rubber parts of any nature. Rubber products should be cleaned with soap solution (one-quarter soap chips to 1 gal water), rinsed with clean water, and dried.

(b) *Unit of Issue.* Bulk: by the gallon.

(c) Uses.

1. Cleaning metal surfaces and bearings.

2. To remove oil and grease spots from vehicle bodies and upholstery.

3. Emergency cleaner for small arm and artillery bores.

4. To clean air cleaners and breathers.

5. Removal of rust-preventive compounds.

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(12) **SOLVENT, METAL CLEANER.** Refer to **POLISH**, metal (type III) paste.

(13) **TRICHLORETHYLENE, TECHNICAL.**

(a) *Characteristics.* A clear, volatile, noninflammable liquid, inhibited against corrosion.

(b) *Containers.*

1. 5-gal can.
2. 55-gal drum.

(c) *Use.* Fluid for vapor degreasing equipment.

(14) **TRISODIUM-PHOSPHATE (CLEANER, PHOSPHATE).**

(a) *Characteristics.*

1. A colorless, crystalline compound which is soluble in water.
2. It is irritating to the skin and personnel handling the solution should wear rubber gloves. The solution will also deteriorate clothing.
3. It should be kept in an airtight storage container.

(b) *Container.*

1. 1-lb package.
2. 100-lb bag.

(c) *Use.*

1. Washing glassware.
2. Washing painted surfaces. **CAUTION:** Only a small space should be cleaned at a time (approx 2 sq ft), and the surface must be rinsed immediately and dried with a wiping cloth; otherwise, an excessive amount of paint may be removed.

(d) *Preparation for Use.*

1. *Glassware.* Two tablespoonfuls of phosphate cleaner to each gallon of water.
2. *Paint.* One half cup of phosphate cleaner to each gallon of water.

c. **Compounds.**

(1) **COMPOUND, CLEANING.**

(a) *Characteristics.* A liquid compound which loosens scales and rust from metal surfaces. It is noncorrosive and will not react on metal or rubber. The package also includes a powder which is used to neutralize the liquid cleaner.

(b) *Package.* 1-lb 4-oz package.

(c) *Use.* Cleaner and neutralizer for cleaning of internal combustion engine cooling systems.

(2) **COMPOUND, CLEANING, ALKALINE.**

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(a) *Characteristics.* An alkaline, granular, solid compound, soluble in water.

(b) *Containers.*

1. 25-lb container.
2. 100-lb container.
3. 400-lb container.

(c) *Use.* In shops to remove grease, tar, paint, etc., from metal parts and radiators. Not to be used on aluminum or zinc.

(d) *Application.* In dip tank. Solution of approximately 1 lb compound to 3 gal water at 180° F - 200° F.

(3) **COMPOUND, GREASE CLEANING.**

(a) *Characteristics.* A compound soluble in kerosene or dry-cleaning solvent, the mixture of which emulsifies with water.

(b) *Container.*

1. 5-gal can.
2. 55-gal drum.

(c) *Use.* For dissolving grease and oil from engine blocks, chassis, and parts.

(d) *Application.*

1. Solution of one part compound to four parts of kerosene or dry-cleaning solvent applied with brush or spray gun.
2. Removed by washing off with cold water.

(4) **COMPOUND, PAINT STRIPPING, ALKALI TYPE.**

(a) *Characteristics.* An alkaline compound, soluble in water.

(b) *Containers.*

1. 100-lb container.
2. 400-lb container.

(c) *Use.* In shops for removing paint, lacquer, and enamel from metal surfaces. Not to be used on aluminum.

(d) *Application.* Hot solution of 3 lb of compound to each gallon of water, applied by flow, trickle, or brush.

(5) **COMPOUND, VAPOR CLEANING.**

(a) *Characteristics.* A granular product soluble in water. The solution, when applied hot to greasy surfaces, emulsifies the greases and oils so that they may readily be removed with hot water or steam.

(b) *Containers.*

1. 125-lb drum.
2. 425-lb drum.

(c) *Use.* Added to water for use in steam cleaning appliances, such as the Steam Jenny. **CAUTION:** When using vapor or steam

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cleaning devices, protect all electrical equipment such as generator regulators, generators, starters, distributors, etc., from direct impact by the cleaning jet. Either remove the accessory or protect adequately to prevent entry of moisture, which may cause a short circuit or corrosion. Clean electrical equipment with dry-cleaning solvent.

d. Soaps.

(1) SOAP, CASTILE, WHITE.

(a) Characteristics. A neutral soda soap made from vegetable oils.

(b) Size. 1-lb bar.

(c) Use.

1. Preparation of soap sponging solutions.
2. Substitute for saddle soap in cleaning leather.
3. Lubricant to facilitate mounting tires.
4. Preparation of liquid lens cleaning soap.

(2) SOAP, LIQUID, LENS CLEANING.

(a) Characteristics. This cleaning solution is prepared by adding 2 ounces of castile soap and 2 ounces of ammonium hydroxide to 2 gallons of distilled water. The soap should be shaved and added to warm water to dissolve it completely before it is added to ammonium hydroxide and distilled water.

(b) Container. 1-qt bottle.

(c) Use. Cleaning lenses, optical instruments, and reflectors.

(3) SOAP, PASTE, HAND GRIT.

(a) Characteristics. A paste soap which quickly removes grease and oil from the skin. The hands should be slightly moistened before the soap is used. It is noninjurious to the skin and will not cause chapping or skin irritations.

(b) Package. 1-lb can.

(c) Use. A mechanic's hand soap.

(4) SOAP, SADDLE (COMPOUND, LEATHER CLEANING).

(a) Characteristics. A soft paste type soap especially prepared for the cleaning and preservation of leather. It readily emulsifies in water and the cleaning action is not as harsh as when other types of soap are used.

(b) Package. 1-lb can.

(c) Use. To clean and preserve leather.

e. Miscellaneous.

(1) PAPER, LENS, TISSUE.

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(a) Characteristics. A white, light-weight, delicate tissue paper.

(b) Unit of Issue. Book of 100 sheets, 7½ in. x 11 in.

(c) Use. For cleaning optical glass or lenses of sighting and fire control materiel.

(d) Method of Handling.

1. Keep this paper in a dry, clean place, free from dust, dirt or grit, which might scratch an optical surface.

2. Do not use more than once.

(2) POLISH, METAL, PASTE, TYPE III.

(a) Characteristics. An iron oxide base paste, so fine in consistency that it has only a mild abrasive action.

(b) Container. 1-lb can.

(c) Use. For polishing metal surfaces. Not to be used on painted, varnished, or lacquered surfaces, or on special finishes, such as browning or parkerizing.

(3) POWDER, SCOURING (FOR) FLOORS, TYPE C.

(a) Characteristics. A powder which is mixed with water. Proportions to use are indicated on the package.

(b) Containers.

1. 1-lb can.

2. 300-lb barrel.

(c) Use. For cleaning grease, oil, and dirt from wood and concrete floors.

(4) SODA ASH, TYPE I.

(a) Characteristics.

1. A white, odorless powder, also called sodium carbonate. It is alkaline in nature and is soluble in water but not alcohol.

2. Solutions containing this compound will attack aluminum and will remove galvanizing. Care should be taken to prevent it from coming into contact with the eyes or skin.

(b) Packages.

1. 1-lb box.

2. 100-lb box.

(c) Uses.

1. Sponging solution for cleaning artillery bores, breeches, and powder chambers.

2. To remove grease and oil preparatory to painting.

3. General cleaning purposes.

(5) SODA, CAUSTIC (LYE).

(a) Characteristics.

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1. A highly caustic substance which readily dissolves in water. It is very destructive to the body and clothing, causing burns on the skin. Special care must be taken to avoid getting any in the eyes.

2. If taken internally, give large dosage of vinegar or lemon juice, followed by butter, olive oil, or cottonseed oil. Assist vomiting by drinking large quantities of tepid water. Precautions should be taken to prevent inhaling small particles when handled in a dry form.

3. Solutions should be kept in containers of iron or glass. Do not use aluminum or galvanized containers.

(b) Containers.

1. 16-oz can.
2. 50-lb drum.

(c) Use. CAUTION: Do not use on artillery materiel or phosphate finishes of small arms.

1. Preparation of paint remover.
2. Preparation of target paste.
3. To quicken the action of other cleaning solutions.

Section IV

FLUIDS AND RECOIL OILS

15. RECOIL FLUIDS, PREPARATION AND HANDLING.

a. Glycerine-water Recoil Fluid.

(1) Glycerine-water recoil fluids are prepared as follows: 60 parts by volume glycerine, U.S.P.—40 parts by volume distilled water; or 50 parts by volume glycerine, U.S.P.—50 parts by volume distilled water. To each 3 gallons of either mixture, add 1 ounce of sodium hydroxide (1 lb sodium hydroxide to 48 gal). Caustic soda (lye) must not be used. The 50-50 mixture is used in certain recoil cylinders only above 0° F, whereas the 60-40 mixture, when prescribed, is satisfactory for all operating temperatures. For specific applications, refer to pertinent War Department Lubrication Orders of Technical Manuals.

(2) Increase of sodium hydroxide content above that specified in the formula will destroy leather or other packings. Glycerine-water recoil fluids should be replaced with fresh liquid whenever it is found necessary to drain cylinders. Extreme care should be taken to see that the proper recoil fluid is used when refilling cylinders.

(3) Drainings will be conserved for use in preparing a sponging

FLUIDS AND RECOIL OILS

solution for cold weather, but, because of the alkali content, it must not be used as an antifreeze coolant for internal combustion engines, as it would result in quick destruction of the radiator.

(4) In cases of emergency, the old liquid may be strained and used for refilling of the recoil mechanism.

b. Recoil Oils.

(1) USE. The greatest care must be taken not to use any oil in a recoil mechanism except the grade and kind prescribed for it. The specific recoil oil to be used with a given weapon is specified in the pertinent War Department Lubrication Order and/or Technical Manual provided for the materiel.

(2) CARE (FOREIGN MATTER).

(a) Recoil oil should not be transferred from one container to another one unless it is properly marked with the exact name of the oil as listed in SNL K-1. Great care must be taken to maintain correct labels on all oil containers so that the oils will be put to their proper use.

(b) Recoil oils should never be left in open containers.

(c) Recoil oils must not be subjected to excessive heat.

(d) The greatest care must be taken to exclude moisture and dirt.

(3) WATER OR MOISTURE.

(a) It is important that no water be introduced into recoil mechanisms that use recoil oil, as the water greatly increases the rate of corrosion and may result in pitting of the finished surfaces, interfering with the functions of the recuperator, and reducing its normal serviceable life.

(b) In spite of the great care taken in preparation and shipping recoil oils, water is often found to be present. Exposure in an open can, even if the top is covered with a cloth, will result in accumulation of moisture from the air. Condensation in a container partly filled with oil, or pouring from one container to another which has moisture on its inner walls, results in moisture being carried along with the oil into recoil mechanisms.

(c) It is advisable that organization commanders test the recoil oil on hand before use for water content. If a clean, dry, glass bottle of about 1-pint capacity is filled with the recoil oil after agitation in the original container, then capped and allowed to settle, the water being heavier than the oil, will sink to the bottom. With the bottle slightly tilted, drops or bubbles of water will form in the lower corner of the bottle. If the bottle is then inverted with this corner uppermost and held to the light, such drops or bubbles may be seen slowly sinking in the oil. If the oil has a cloudy appearance the cloudiness may be ascribed to minute particles of water in suspension. If a shal-

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b. Nearly all Ordnance leather equipment is russet or fair leather, and, when these articles become soiled, they should be cleaned by carefully removing all hardened grease with a sliver of wood (not glass or knife), and washed with a sponge saturated with a heavy lather of saddle soap and clean, tepid water. Do not use hot water or allow the leather to soak. Rinse thoroughly with clear water and rub vigorously with a dry cloth until the leather is dry. Straps and other articles of unvarnished leather, which become dry and brittle, should be cleaned, and while the leather is still moist, be given an exceedingly light coat of neat's-foot oil by rubbing with a soft cloth moistened (not saturated) with the oil. Wipe off any excess oil the leather does not absorb and rub to a polish, if desired. In cold weather, the oil may be heated lukewarm (never hot) before using, and the article hung in a warm place after being oiled. Shellacked sole-leather cases do not require oiling.

c. Leather equipment must never be washed with a strong cleaning solution containing alkali, since alkali has a deteriorating effect on leather goods.

d. Russet leather, as manufactured, is stuffed with a dubbing of cod liver oil and tallow. Enough of this is absorbed to improve the quality and prolong the life of the leather, but not enough oil remains on the surface to soil the clothing if the equipment is properly cared for. It should be noted that if more than a light coat of oil is applied in the washing and oiling described above, the leather will be greatly darkened and quickly soil the clothing. No method of cleaning can then restore the original light color of the leather or remove stains from it.

e. Articles of black leather may be cleaned with saddle soap and then rinsed. When nearly dry, they should be lightly sponged with a mixture of 1 teaspoonful of lampblack in 1 pint of neat's-foot oil, the mixture having first been stirred until it has a glossy black appearance. The mixture should then be well rubbed into the leather.

f. Leather equipment, which has become wet, should be dried in the shade. Wet leather, exposed to the sun or a hot stove or radiator, becomes hard and brittle.

36. WATERPROOFING CANVAS AND DUCK USED FOR TARPULINS, TOPS, CURTAINS, ETC.

a. General.

(1). These directions pertain to the field application of a compound for the treatment of canvas and duck, as used for tarpaulins, tops, curtains, etc., on, or in connection with, military materiel. Treat-

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ing compound for canvas leggings and duck, is a fluid which can be sprayed or brushed on canvas to make it water-, weather-, and mildew-resistant. This compound, when properly applied on one side of the canvas, will not penetrate and discolor articles placed against the other side. Flexibility and strength of canvas are not materially affected by the compound. When the compound is applied to one side of the canvas by brush, 1 gallon will cover approximately 150 square feet; when sprayed on one side of canvas, coverage will be approximately 450 square feet per gallon.

b. Cleaning.

(1) The surface to be treated must be clean and thoroughly dry. Stretch the canvas or duck taut and suspend it with the seams vertical.

(2) Remove mud and dirt with a clean dry brush. If necessary, scrub with a brush and clear water. If water is used, the material must be dry before treatment is applied.

(3) Mildewed canvas is best cleaned by scrubbing with a dry brush. If water is necessary to remove dirt, it will not be used until all mildew is removed.

(4) If mildew has been present, examine fabric carefully, by stretching and pulling, for evidence of rotting or weakening of fabric. If fabric shows indications of loss of strength, it is probably not worth treatment.

(5) Oil and grease can be removed by scrubbing with issue soap and warm water. Rinse thoroughly with clear water and dry. **CAUTION:** *At no time will gasoline or solvent be used to remove oil or grease.*

c. Application. Before applying the compound, stir it until it is mixed thoroughly. Treat only one side of canvas (the weather or outer side). Application may be made by the methods listed below. **NOTE:** *In both cases, especially when using a brush, the compound must be worked well into the seams.*

(1) **WITH A SPRAY GUN.** Using closely confined spray, apply in quick, horizontal strokes. This application should be made from the top to the bottom, one panel at a time, in sufficient quantity to keep a moderate flow running down the surface. Stop marks may be removed by brushing before the compound is dry.

(2) **WITH A 4-INCH, FLAT PAINT BRUSH.** The brush should be kept full of the compound, and application made evenly in vertical strokes from top to bottom, one panel at a time.

d. At least 24 hours drying time should be allowed before the treated canvas is used.

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e. Since this compound is inflammable, care must be exercised in its handling. It is recommended that a respirator be worn when spraying, and that the hands be protected with cotton gloves or a protective cream. Hands and equipment may be cleaned with dry-cleaning solvent. The skin then should be washed with soap and water to avoid irritation.

f. Fading of treated canvas results from loss of the compound, with corresponding loss of waterproofing qualities. Faded spots may be recolored by rubbing the surface with a cloth dampened with thinner. When this is no longer effective, refinishing may be done without preparation other than cleaning and drying thoroughly.

37. PROTECTING INTERNAL COMBUSTION ENGINE WATER COOLING SYSTEMS.

a. Preparation of Cooling System.

(1) It is necessary that the cooling system of the vehicle be clean, particularly of rust. If the cooling system was cleaned and inhibited, it may be necessary only to drain, refill with clean water, and again drain. If the cooling system has not been cleaned, clean in accordance with directions in paragraph 13 a (2) (a) to (d).

(a) Heaters, water-cooled compressors, etc., connected into the cooling system must be cleaned together with the radiator and block. When the system is drained, the instructions in the pertinent Technical Manual should be followed to assure that the system is drained completely.

(b) All hoses should be inspected and replaced if deteriorated. All connections, plugs, and pet cocks should be inspected and made watertight. If there is evidence of exhaust gas or air leakage into the system, necessary correction must be made.

(c) Inspect thermostat to see that it closes completely. Look for evidence of sticking in open or closed position. Operation of the thermostat may be checked by heating in a pan of water to make certain that it will open in hot water. If thermostat does not open or close completely and function freely, or is badly rusted, it should be replaced.

(d) Tighten cylinder head bolts as prescribed in applicable Technical Manual to prevent leakage of coolant. The cylinder head bolts should also be checked once a month during the winter season to determine that no seepage of coolant is taking place.

(2) When servicing the engine for operation at anticipated temperatures above +32° F, nearly fill the system with clean water. Add corrosion inhibitor compound in the proportion of one container of inhibitor to each 4 gallons of cooling system capacity including ac-

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cessories. Then complete filling the system with water. The capacity of the cooling system can be obtained from the applicable Technical Manual.

(3) When servicing the engine for operation at anticipated temperatures below +32° F, use the procedure prescribed for reclaimed or new anti-freeze, whichever is to be used.

b. Use of Reclaimed Solution.

(1) Reclaimed solutions should be used up, as far as practicable, in administrative vehicles. Never use reclaimed solution in vehicles in combat service.

(2) Initial preparation of old solutions is accomplished as follows:

(a) Place drum containing the old solution on a rack and install tap.

(b) Test for strength with a hydrometer and discard all solutions testing above +20° F.

(c) Strain a sample through muslin or several thicknesses of cheesecloth into a clean glass container. Solution should be green or blue. Discard all solutions with brown or rusty tint.

(d) If the solution tests higher than the temperature to which the protection is required, determine the amount of new antifreeze compound (ethylene glycol type) required to reach the desired protection from table 1, below.

For example: If the solution tests +10 and the desired protection is -30, reading the table indicates that 2½ pints of antifreeze compound should be added to 5½ pints of reclaimed solution to make 1 gallon (8 pt) of satisfactory antifreeze.

TABLE 1
PINTS TO BE ADDED TO OLD SOLUTION TO MAKE 1 GALLON (8 PINTS) OF RECLAIMED SOLUTION.

Solution Strength	Desired Protection							
	+10	0	-10	-20	-30	-40	-50	-60
+20° F	1	1½	2¼	2¾	3	3½	4	4¼
+10° F	—	1	1½	2	2½	3	3¼	3¾
0° F	—	—	¾	1¼	1¾	2¼	2¾	3¼
-10° F	—	—	—	¾	1¼	1¾	2¼	2¾
-20° F	—	—	—	—	¾	1	1¾	2¼
-30° F	—	—	—	—	—	¾	1¼	1¾
-40° F	—	—	—	—	—	—	¾	1¼
-50° F	—	—	—	—	—	—	—	¾

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(e) Strain the old solution through muslin or several thicknesses of cheesecloth into a clean container in which the quantities can be measured, and from which the solution can be poured into the radiator of the vehicle.

(f) Add the determined quantity of antifreeze compound for each gallon of reclaimed solution.

(3) When the cooling system is clean and tight (par. 13), the strained antifreeze of the proper strength should be added. After filling to the proper level, add one container of corrosion inhibitor compound for every 4 gallons of antifreeze solution in the radiator. **NOTE:** Any vehicle having an additional capacity, due to additional accessories, requires additional containers of inhibitor compound. The contents of the container should be poured into the radiator while the engine is idling and at normal operating temperature to obtain thorough mixing.

(4) While the engine is warm, the solution strength should be checked with a hydrometer and strengthened, if necessary.

(5) Inhibitor compound is available on requisition as COMPOUND, inhibitor, corrosion. **NOTE:** If corrosion inhibitor is not immediately available, it must be added at the earliest possible moment.

c. Use of New Solutions.

(1) Prepare the cooling system in accordance with directions in paragraph 13 a (2).

(2) The following table may be used in determining the amount of antifreeze compound necessary for protection at the specified temperature.

TABLE 2.
GUIDE FOR PREPAIRING FRESH ANTIFREEZE SOLUTIONS.

Protection to	Pints of COMPOUND Antifreeze To Be Added To Make 1 Gallon of Antifreeze Solution
+10° F	2
0° F	2 1/2
-10° F	3
-20° F	3 1/2
-30° F	4
-40° F	4 1/2
-50° F	5
-60° F	5

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For example, to protect to -20° F, 3 1/2 pints of antifreeze compound are required per gallon (8 pts) of antifreeze solution. Therefore 3 1/2 pints of antifreeze compound are added to 4 1/2 pints of water for each gallon of antifreeze solution required.

NOTE: The mixture of 60 percent antifreeze compound and 40 percent water gives maximum protection. Stronger solutions of antifreeze compound have higher freezing points.

(3) INSTALLATION OF ANTIFREEZE SOLUTION.

(a) Fill system about one third full of water. Then add the amount of antifreeze compound required for the capacity of the entire system, including accessories such as heaters, etc., and fill with water to slightly below the filler neck.

(b) After installing the solution, run the engine until normal operating temperature is reached and the thermostat is open. Check the solution with a hydrometer and strengthen if necessary. Finally, fill system to prescribed level.

CAUTION: Do not add inhibitor to freshly prepared antifreeze solutions.

d. Notes on Use of Antifreeze Solution.

(1) In service with either new or used solution, the coolant should be inspected weekly for strength and color. If the solution becomes rusty, it is to be discarded, the cooling system thoroughly cleaned, and new solution added. Do not discard rusty solution until new solution is available.

(2) In handling antifreeze solution, it is essential that it be kept clean. Use containers and water that are free from dirt, rust, and oil.

(3) Always use an accurate hydrometer. To test the hydrometer, make a solution of one part antifreeze compound and two parts of water. This solution should give a reading on the hydrometer of protection to 0° F.

(4) Antifreeze compound (ethylene glycol type) is the only antifreeze authorized for use in Ordnance vehicles.

38. PREVENTION OF GUM FORMATION IN FUEL SYSTEMS OF GASOLINE POWERED VEHICLES.

a. General.

(1) Gasoline stored in contact with air tends to oxidize and form a resinous compound of a gummy nature. Storage at elevated temperatures, with half filled fuel systems, and the presence of certain metals, such as copper, accelerate this decomposition. Eventually, as the decomposition progresses, the gummy material settles out in fuel

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tanks, lines, and carburetors, clogging screens and causing moving parts to stick.

(2) When gasoline, which has begun to deteriorate, is burned in the engine, the gum is not entirely consumed, thus resulting in deposits, particularly on intake valves, where it causes valve sticking by acting as a binder for other products of combustion. The gum also acts as carbon binders in the combustion chamber and accelerates excessive formations therein.

(3) The addition of suitable oxidation inhibitors and metal de-activators to gasoline which has a tendency to form gum, but which has not begun to deteriorate, will prevent the formation and deposition of gum during storage periods up to 6 months. Gum preventive compound is a solution of suitable oxidation inhibitors and metal de-activators for addition to the gasoline in vehicles, or gasoline engine powered equipment which are to be inoperative for long periods, to prevent the deposition of gum in the fuel systems.

b. Instructions for Use.

(1) All vehicles or other equipment, powered by gasoline engines, or having gasoline auxiliaries, which are to remain idle for 30 days or more, and which are to be stored with gasoline of questionable storage stability or any fuel meeting U. S. Army Specification 2-114 (72 octane) in the fuel system, will have the fuel treated with gum preventive compound.

(2) The fuel systems of equipment to be treated must be free from accumulated gum. Unless equipment is entering its first storage, the following parts should be inspected and cleaned:

(a) Fuel Pump.

1. Valves.
2. Screens.

(b) Carburetor.

1. Screens.
2. Accelerator pump plunger.
3. Venturi of carburetor throat.
4. Choke and throttle valves.
5. Float mechanism.

(c) Fuel Lines and Fuel Tank and Screens.

(3) If gum is present in the above parts, it can best be removed with benzol, acetone, alcohol, or a mixture of these solvents. Deposited gum is not readily soluble in fresh gasoline. When gum has dried, it may be necessary to resort to mechanical means to remove it.

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(4) Parts which cannot be thoroughly cleaned and freed from the gum deposit without damage should be replaced.

(5) After cleaning and reassembling, fill fuel tank half full with fresh gasoline which has not been long in storage.

(6) Add gum preventive compound in accordance with the following tables:

Fuel Tank Capacity	Amount of Compound
1-30 gal	1 container (4 oz)
30-60 gal	2 containers (8 oz)
60-90 gal	3 containers (12 oz)

(7) Fill fuel tank to capacity.

(8) Operate the equipment at least 5 minutes.

CAUTION: *It is to be pointed out that gum preventive compound is a preventive measure only and not a corrective agent. It cannot, therefore, be expected to remove gum which has already deposited nor can it be expected to prevent gum deposition from gasoline which has already deteriorated as a result of storage. It is effective only as a means of improving the storage characteristics of fresh gasoline.*

39. PRESERVATIVE MATERIALS.

a. Antifreeze and Corrosion Inhibitor.

(1) COMPOUND, ANTIFREEZE (ETHYLENE GLYCOL TYPE).

(a) Characteristics.

1. A transparent, usually blue-green liquid, consisting of ethylene glycol, plus a rust inhibiting compound.

2. When mixed with water in the prescribed proportions, i.e., 60 percent antifreeze compound to 40 percent water, by volume, the resulting solution will not freeze at temperatures down to -60°F . This mixture produces the lowest freezing point; stronger solutions have higher freezing temperatures.

(b) Container. 1-gal. can.

(c) Uses.

1. Water-cooled internal combustion engine cooling systems below $+32^{\circ}\text{F}$.

2. Substitute for alcohol or glycerine in water-cooled machine gun jackets below $+32^{\circ}\text{F}$.

3. Substitute for alcohol or glycerine in bore sponging solutions below $+32^{\circ}\text{F}$.

(2) COMPOUND, INHIBITOR, CORROSION (FOR WATER OR RECLAIMED ANTIFREEZE COMPOUND).

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Section IX

REFERENCES

79. PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes or revisions of the references given in this section and for new publications relating to materiel covered in this manual:

- a. Introduction to Ordnance Catalog (explaining SNL system) ASF Cat. ORD 1 IOC
- b. Ordnance Publications for Supply Index (index to SNL'S) ASF Cat. ORD 2 OPSI
- c. List of Publications for Training (listing MR's, MTP's, FM's, TM's, TR's, TB's MWO's, SB's, WDLO's, and FT's) FM 21-6
- d. List of Training Films, Film Strips, and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject) FM 21-7
- e. Military Training Aids (listing graphic training aids, models, devices, and displays) FM 21-8
- f. Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to Ordnance personnel, FSMWO's, OPSR, BSD, S of SR's, OSSC's, and OFSB's and includes alphabetical listing of Ordnance major items with publications pertaining thereto) OFSB 1-1

80. STANDARD NOMENCLATURE LISTS.

- Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items ORD 5 SNL K-1
- Soldering, brazing, and welding materials; gases and related items SNL K-2

81. EXPLANATORY PUBLICATIONS.

- a. Fundamental Principles.
 - Basic maintenance manual TM 38-250
 - Military chemistry and chemical agents TM 3-215

REFERENCES

- Motor vehicle inspections and preventive maintenance services TM 9-2810
- Precautions in handling gasoline AR 850-20
- Storage of motor vehicle equipment AR 850-18
- b. Lubrication.
 - Cold weather lubrication and service of combat and transport materiel TB ORD 126
 - Cold weather lubrication and service of artillery materiel OFSB 6-5
 - War Department Lubrication Orders.
 - c. Maintenance and Repair.
 - Instruction Guide: Welding—Theory and Application TM 9-2852
 - Preservation and care of seacoast defense materiel TM 4-245
 - Welding TM 1-430
 - d. Protection of Materiel.
 - Decontamination TM 3-220
 - Defense against chemical attack FM 21-40
 - Ordnance maintenance: Fire extinguishers TM 9-1799
 - Preparation of Ordnance materiel for deep water fording TM 9-2853
 - Preservation of Ordnance materiel not in regular use SB 9-28

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